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MULTI-FOCAL IMAGE FUSION TECHNIQUE USING CONVOLUTIONAL NEURAL NETWORK

Abstract:
In this paper, a solution to the problems faced by different images such as multifocal and medical images is found through a simulation process using brain magnetic resonance imaging (MRI) to make a fuse based on previously approved fusion techniques such as convolutional neural networks (CNN). An algorithm is developed with the introduction of the Euclidean distance algorithm as part of the processes to make the implementation faster and more efficient than the traditional CNN. The objective fusion metrics that are commonly used are implementing to make a quantitative evaluation. The proposed system consists of three main phases which are, pre-processing phase, features extraction phase, and classification phase. The preprocessing phase is used to enhance the images by using the techniques of digital image processing. Feature extraction phase is used to get features from medical images based on the concept of Histogram of Orientation Gradient (HOG) technique feature that applied to the medical image after conversion using mean filter, adaptive filter, Discrete Wavelet Transform (DWT), k-means clustering Singular Value Decomposition (k-SVD).

Keywords:
Magnetic resonance imaging, Histogram of Orientation Gradient, Discrete Wavelet Transform, medical images

Introduction

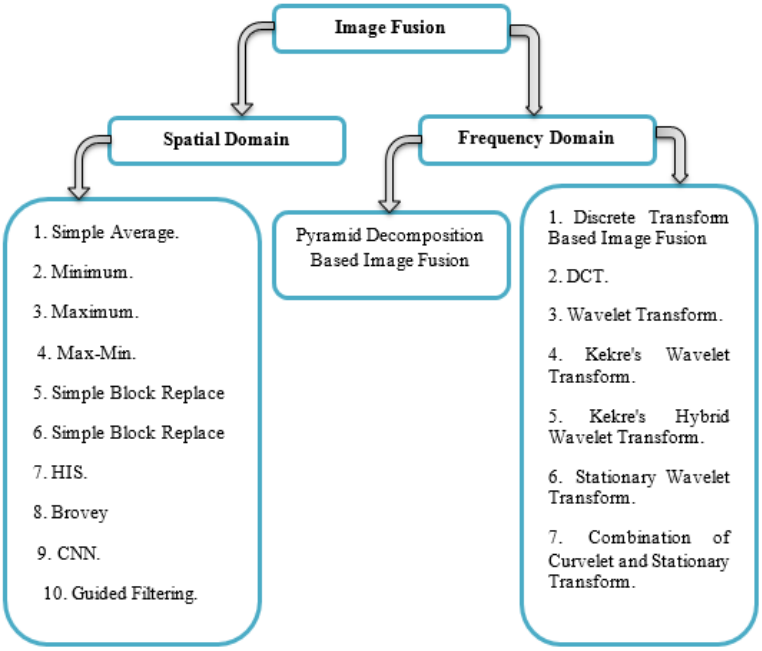
The concept of fusing a sequence of images into a single object began in the 1950s and 1960s by studying useful amalgam image approaches starting from different devices with their most common system called the sensor to give a compound image that can be used to identify real and artificial enterprises [1]. Issues such as merging, alteration, fusion, and integration and many additional terms have since emerged in the fiction to guide more or less the analogous notions. Many forms of remote sensing images are captured digitally and then processed by computers to generate the images for analysis by interpreters. On the other hand, some specialized computer systems are used to create images in which accurate information is generated and highlighted for advanced interactive data processing. In the medical field, many image processing techniques have been created to process X-ray images, and some other images originate from advanced body scanning tools. The initial impetus for remote sensing was the unmanned planetary satellite program in the 1960s that measures or transmits images remotely to receiving stations on earth. The poor quality of the obtained images allowed processing techniques to be developed to make the images accessible. The Landsat programmer, which began in 1972, is another catalyst, and the continued production of faster and more powerful computers, peripheral equipment and applications for image processing is a third impetus [1].

The proposed system

The proposed system consists of three main phases which are, pre-processing phase, features extraction phase, and classification phase. The preprocessing phase is used to enhance the images by using the techniques of digital image processing. Feature extraction phase is used to get features from medical images based on the concept of Histogram of Orientation Gradient (HOG) technique feature that applied to the medical image after conversion using mean filter, adaptive filter, Discrete Wavelet Transform (DWT), k-means clustering Singular Value Decomposition (k-SVD).

A neural network technique [2] with the Euclidean distance algorithm is used in training and testing as a classifier of the medical images in the classification phase. The network is trained using a set of training samples, and then the generated weights are used to test the system's recognition ability with new test images. Image fusion system (IFS) was tested using a standard dataset. This dataset contains brain MRI images with manual anomaly fragmentation masks for attenuated fluid recovery (FLAIR). The images were obtained from the Cancer Imaging Archive (TCIA). It is a set of 3,740 different brain image samples corresponding to 110 patients. Each patient contains 20-70 segmentation of a brain tumor in the MRI images included in the low-grade glioma group Cancer Genome Atlas (TCGA) with at least FLAIR sequencing and data Genomic block available. The results of experiments conducted showed that the use of convolutional neural networks (CNNs) with the Euclidean distance algorithm used in training and testing as a classifier for medical images provides approximate accuracy of 98.18%. Comparing with the findings of other published works these rates are considered high.

Image Fusion Techniques are shown in Fig 1, and Schematic Diagram of Fusing Images - in Fig.2.



Fugure 1 – Image Fusion Techniques

Conclusions

The following conclusions were made based on the presented research.

1. The fusion efficiency is based on the pre-treatment stage to eliminate the defects associated with the image acquisition process.

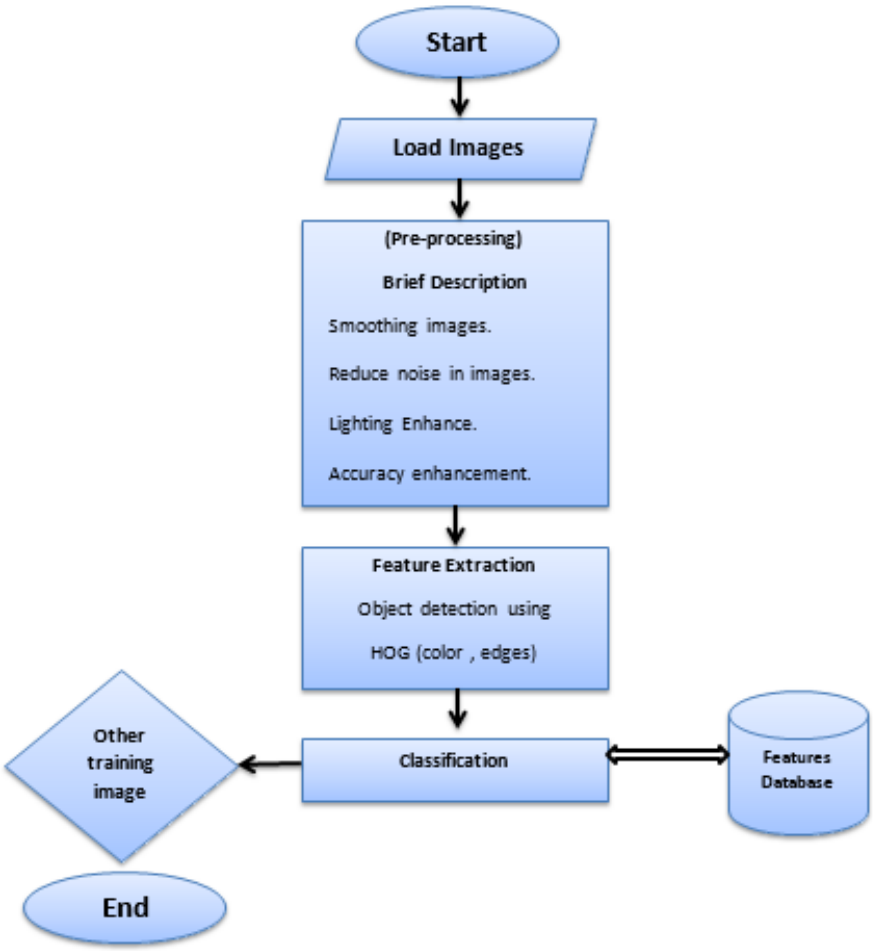
2. Enhanced images will contain the best contrast of the original image where you can find more colors included in the original image that emerged after the optimization process. Sharp edges and clear extended areas are great for describing a merged image.

3. The proposed fusion method is sensitive to the color being RGB.

4. The image fusion system needs to know more than one image for each person to increase the fusion ability.

5. The fusion image system requires more time in Conventional-CNN than in the Modified-CNN algorithm, which added Euclidean distance to train the subnets to choose the appropriate weight vector that can be successfully combined.

6. The ratio between the maximum possible power of the signal and the strength of the corrupted noise affecting the accuracy of its representation of PSNR in Conventional-CNN is, in general, less than the share in the Modified-CNN algorithm which added Euclidean distance.



Fugure 2 – Schematic Diagram of Fusing Images

The proposed algorithm can be improved using the following ways.

1. Only one transformation was used at the Haar wavelet level in this paper. One can try to compare the different wavelet families that contain more than one plane with the presented in the paper.

2. Compare the results obtained using different image formats with the same techniques.

3. Partial training can be used to get shorter training time and better accuracy for new users.

References

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